

# Life Cycle Assessment – CLIC & ILC

March 23 Update Meeting

## **Agenda:**

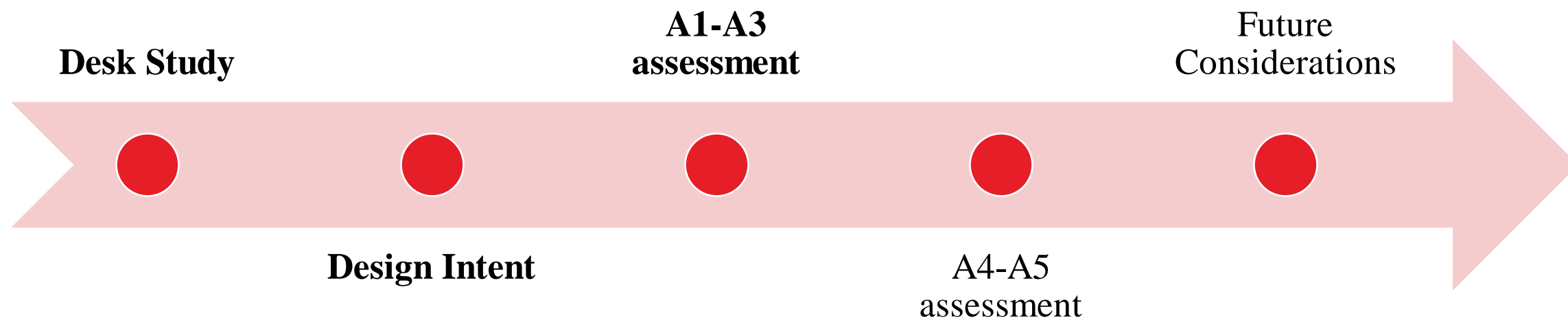
- Progress Overview
- A1-A3 Assessment
- Future Considerations

Suzanne Evans, Yung Loo, Heleni Pantelidou, Jin Sasaki

9<sup>th</sup> March 2023

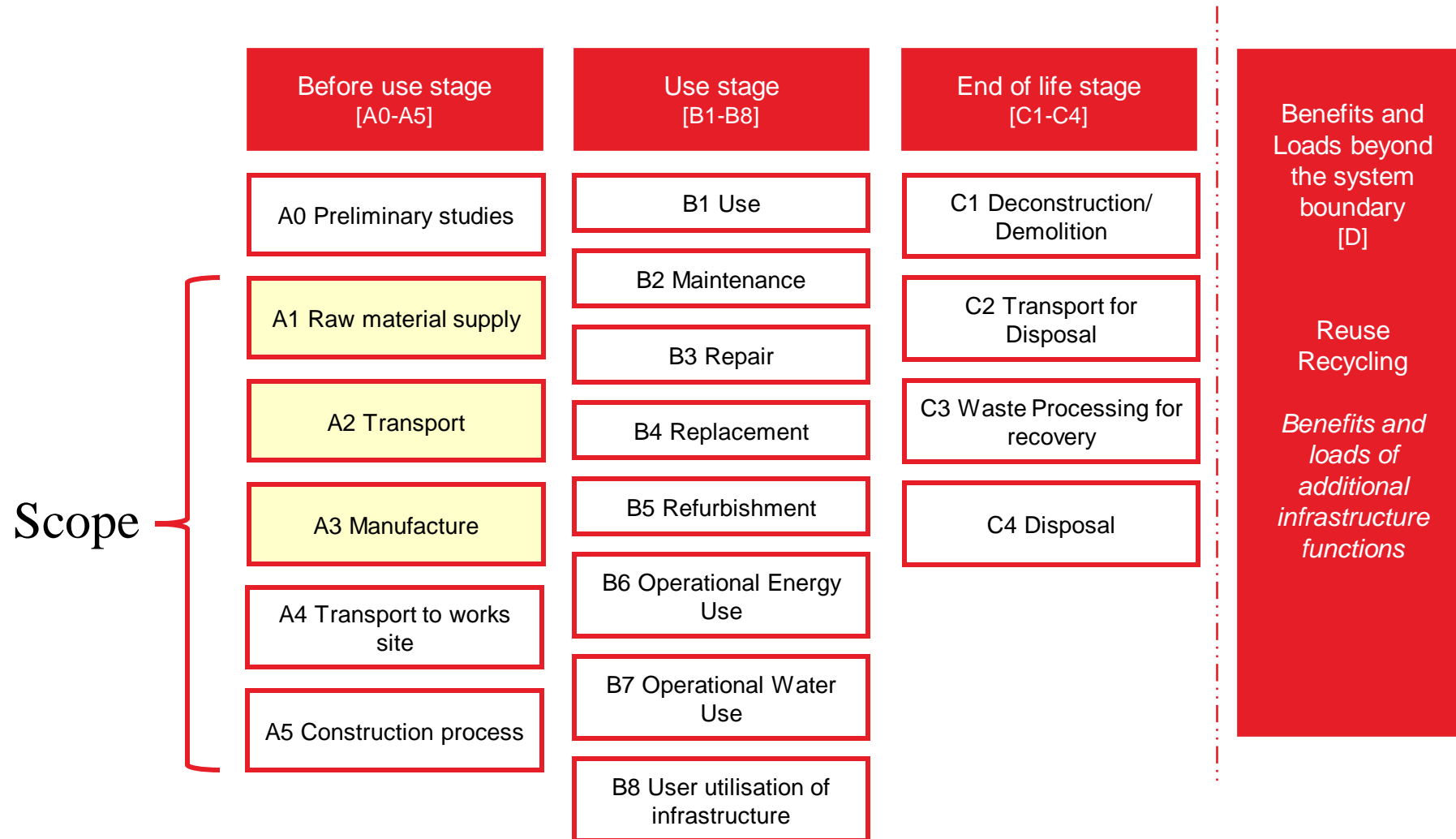
# Life Cycle Assessment – CLIC & ILC

## Progress Overview



# A1-A3 Assessment

# LCA System Boundaries



# LCA Assessment Methodology

## ReCiPe 2016

Global evaluation of 18 impact categories.  
 Applicable to both CLIC and ILC.  
 Established method based on both CML 2002 and Eco-indicator 99.

Midpoint / Endpoint	Midpoint	Midpoint impact categories evaluated in first instance, potential for endpoint to be evaluated in the future.
LCA Tool	Simapro	First principles LCA software with an extensive LCI database.
LCI Database	Ecoinvent	Globally established life cycle inventory database, frequently updated to remain current.

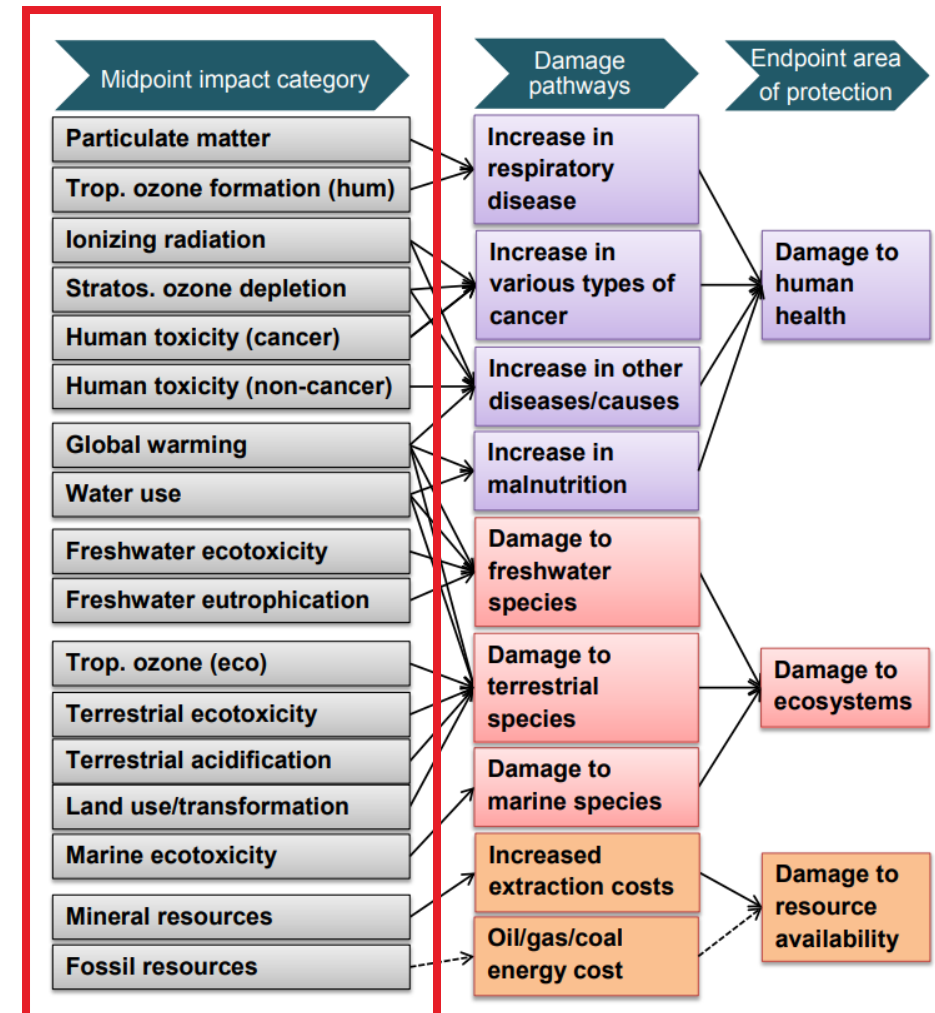


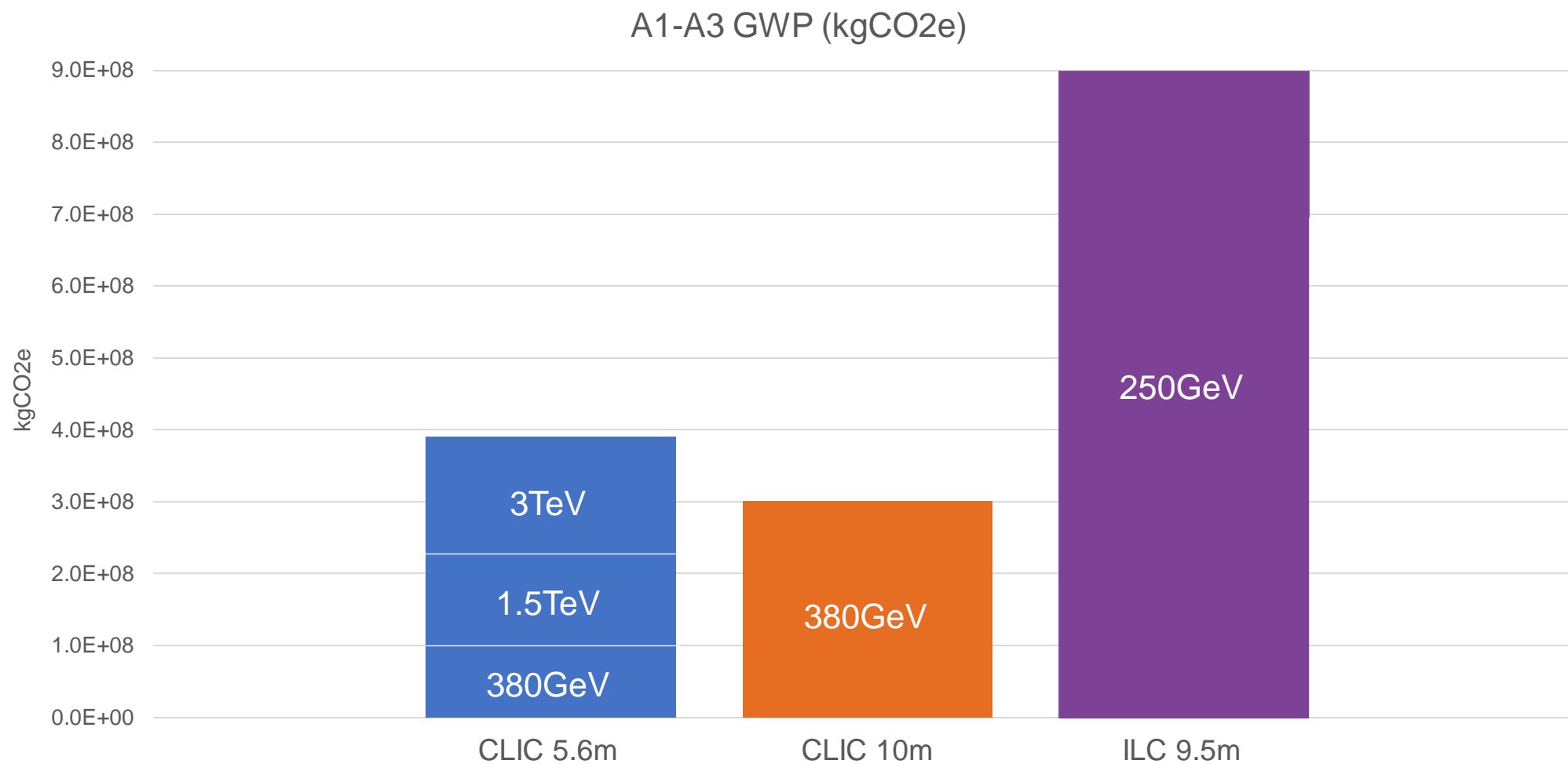
Figure 1.1. Overview of the impact categories that are covered in the ReCiPe2016 methodology and their relation to the areas of protection.

# Asset Hierarchy

System	Sub-system	Components	Sub-components
CLIC 5.6m dia. 380GeV			
	<b>Tunnels and Turnarounds</b>		
		<b>Main accelerator tunnel</b>	Primary Lining Secondary Lining Invert
		<b>Turnarounds</b>	Primary Lining Secondary Lining Invert
	<b>Shafts</b>		
		<b>9-18m dia.</b>	Primary Lining Secondary Lining
	<b>Caverns</b>		
		<b>BDS, UTRC, UTRA, BC2, DBD, Service cavern, IR cavern, Detector and Service hall</b>	Primary Lining Secondary Lining

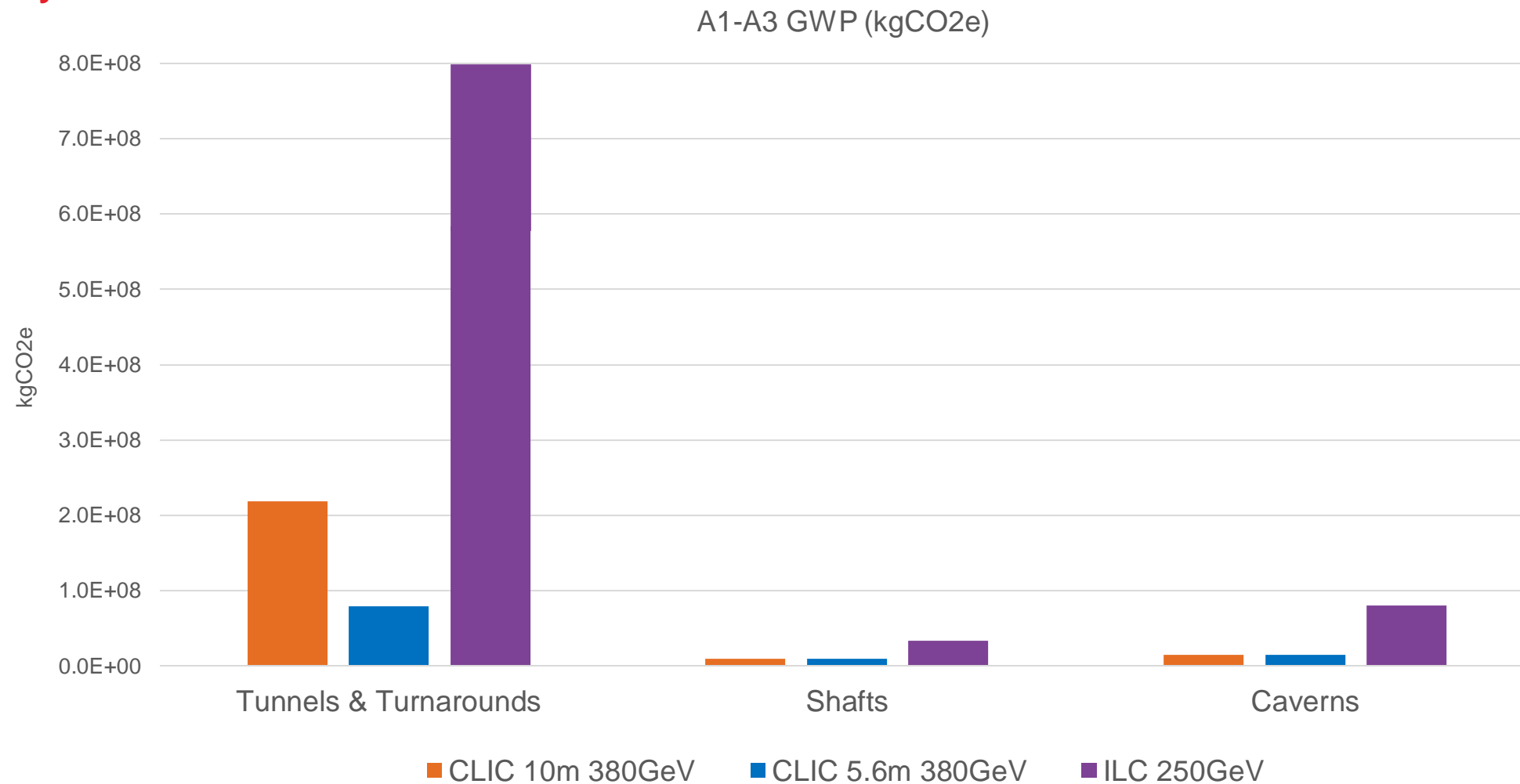
# CLIC & ILC

## System Level



# CLIC & ILC

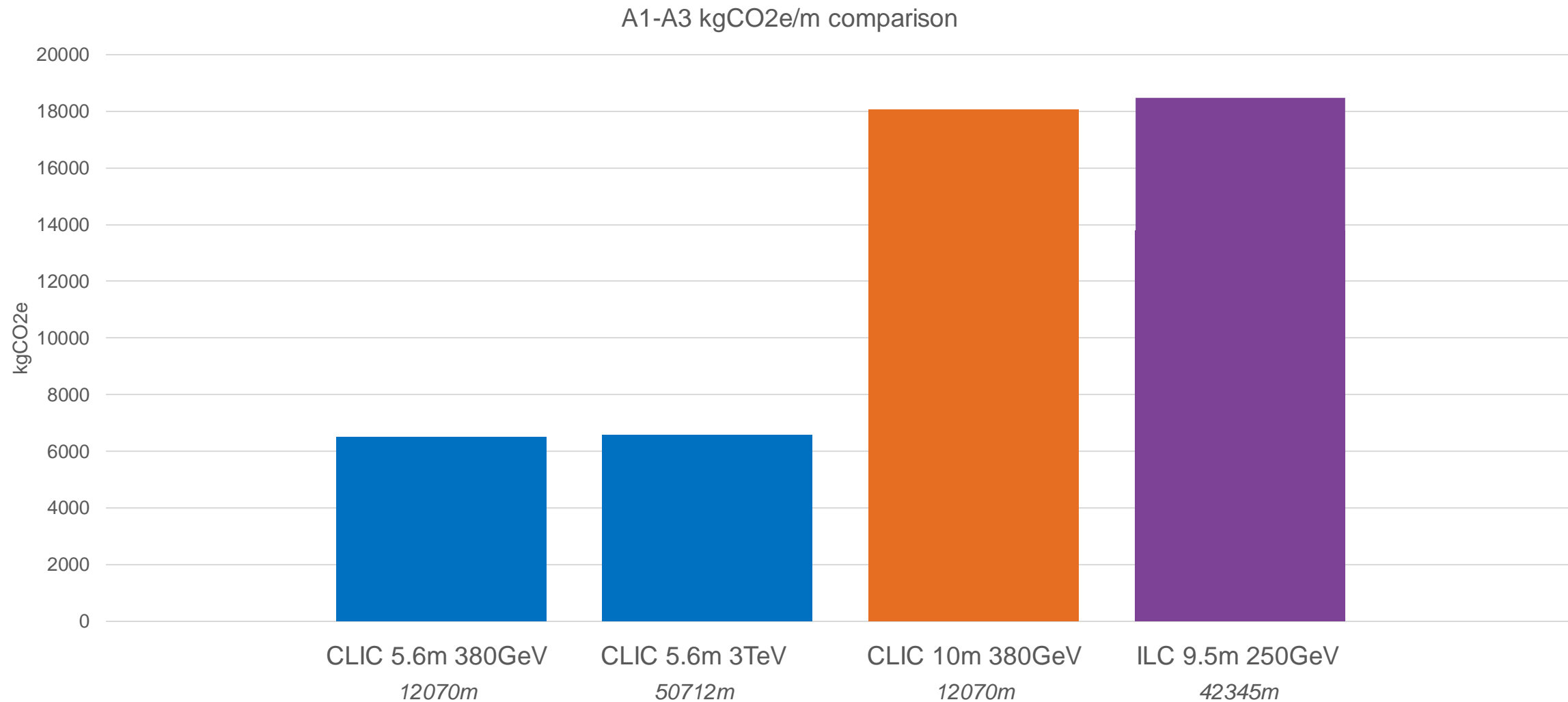
## Sub-system Level





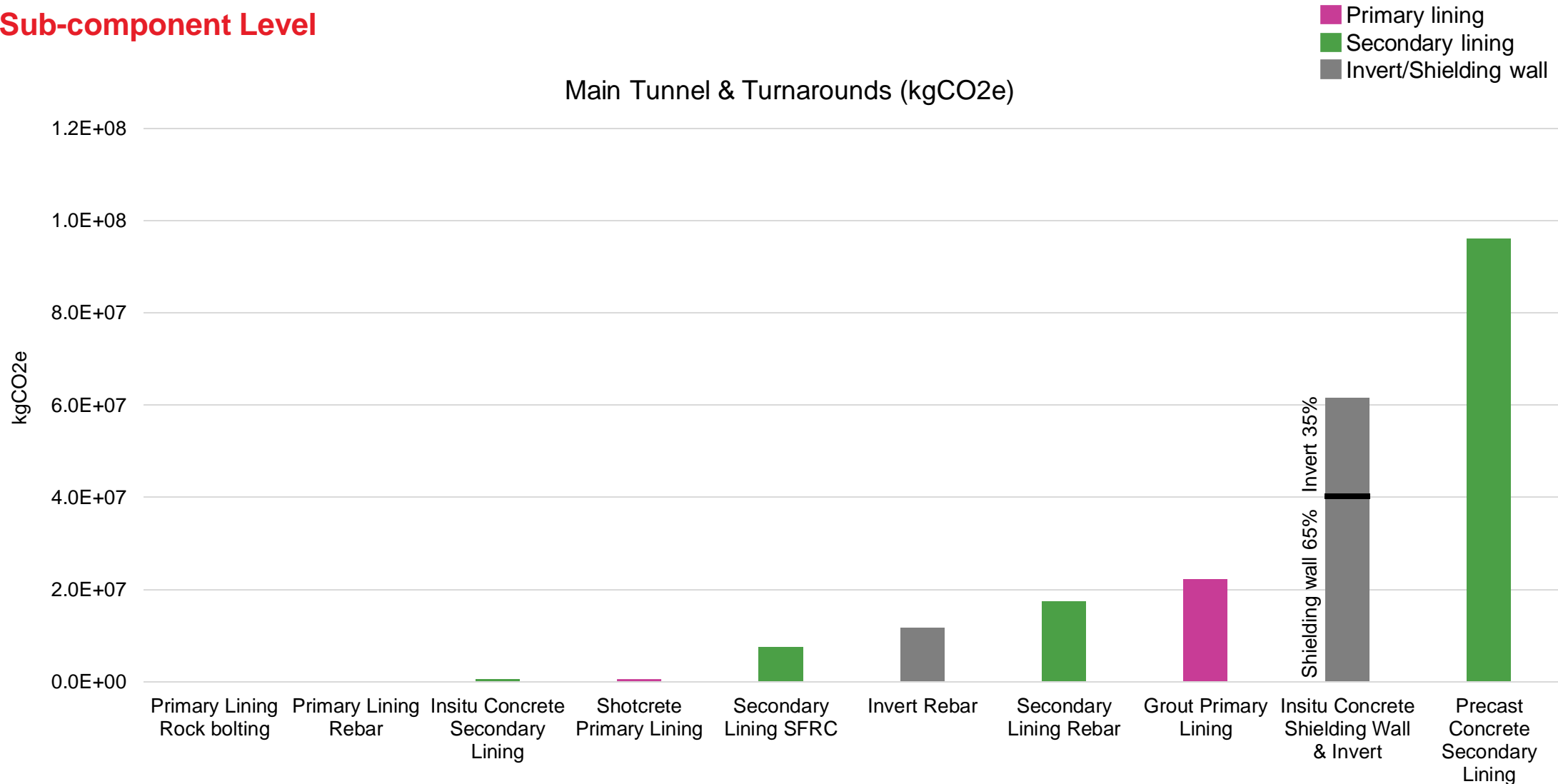
# kgCO<sub>2</sub>e/m Tunnels Comparison

System Level



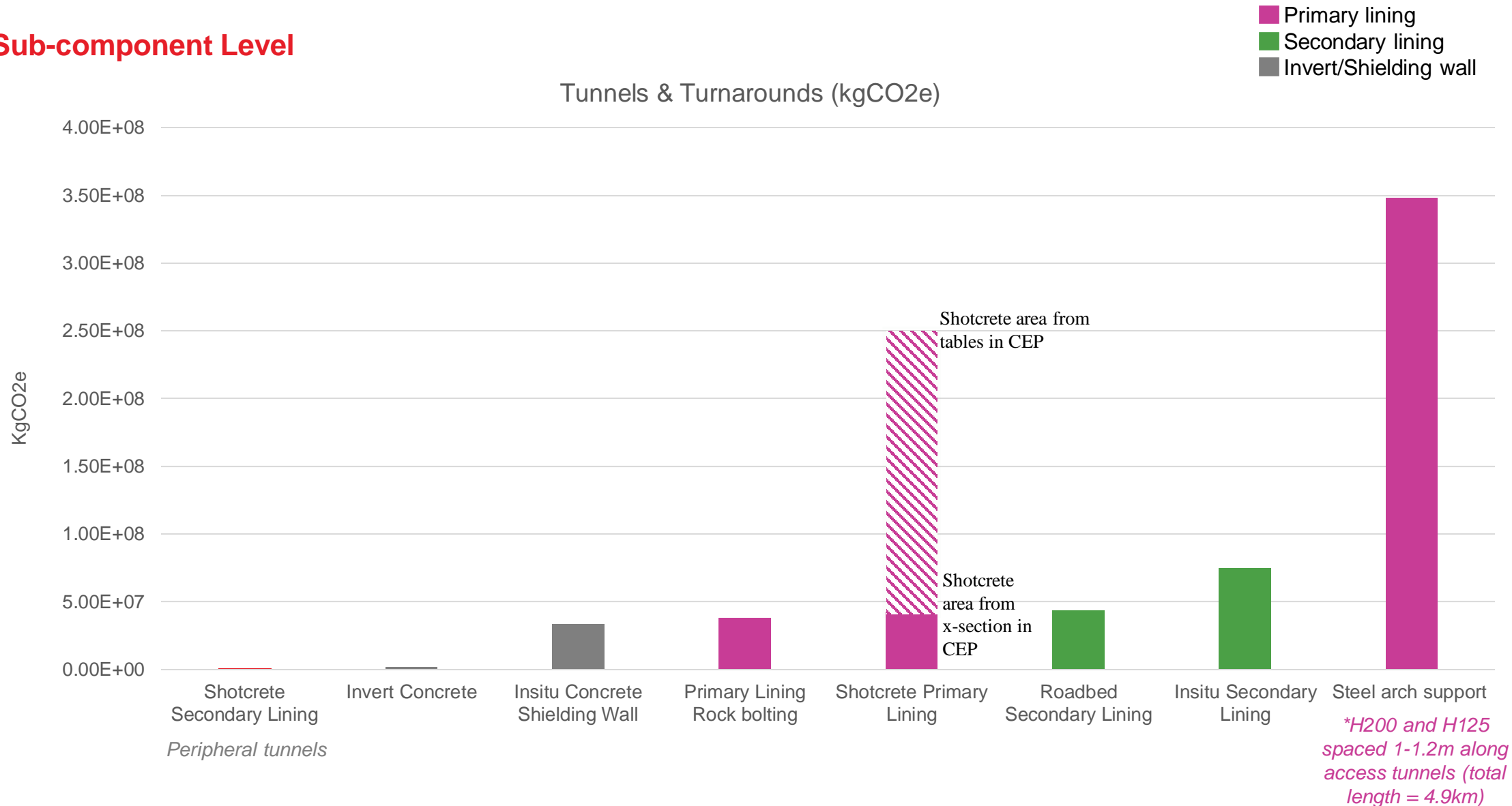
# CLIC 10m 380GeV Tunnels & Turnarounds

## Sub-component Level



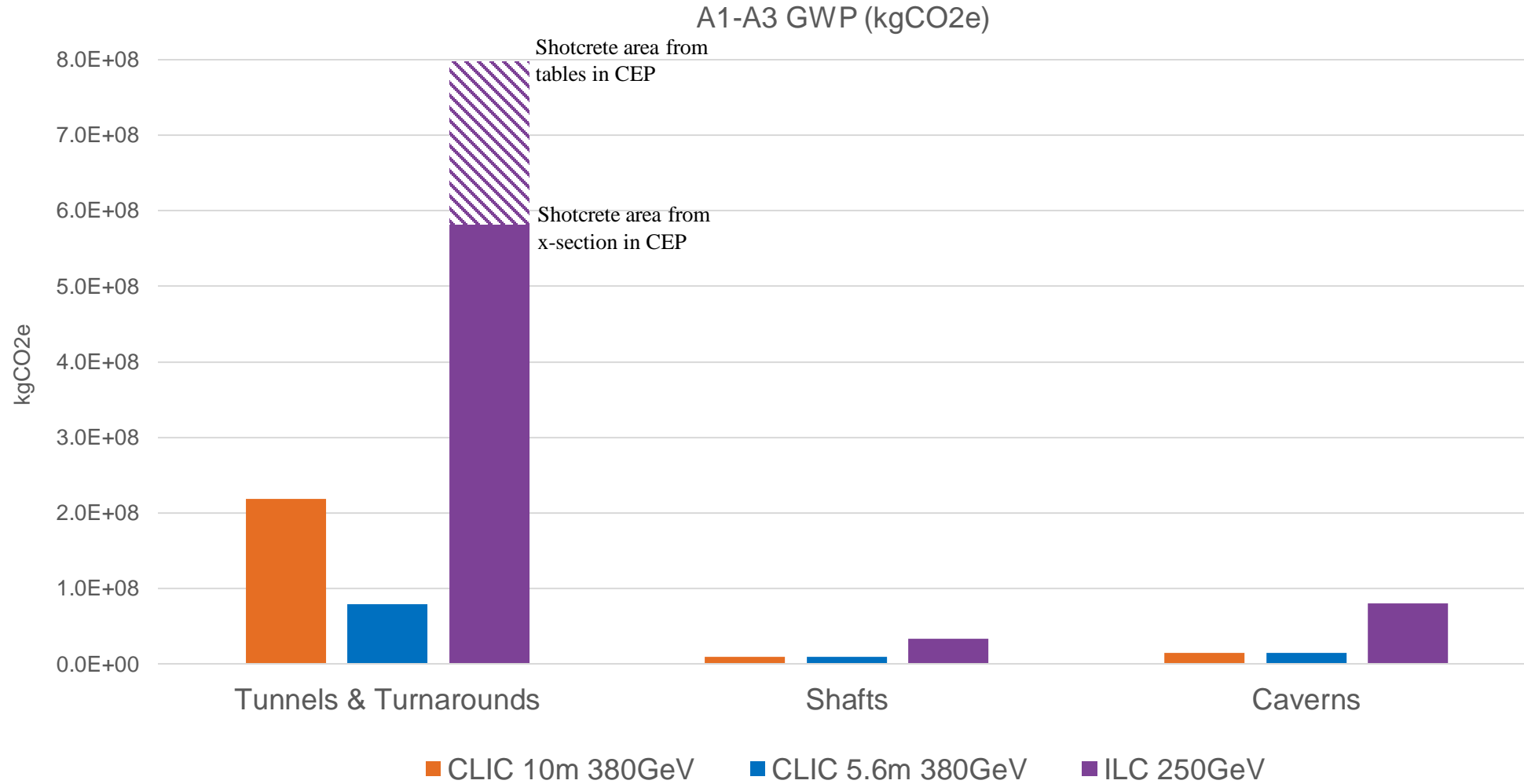
# ILC Tunnels & Turnarounds

## Sub-component Level



# CLIC & ILC

## Sub-system Level

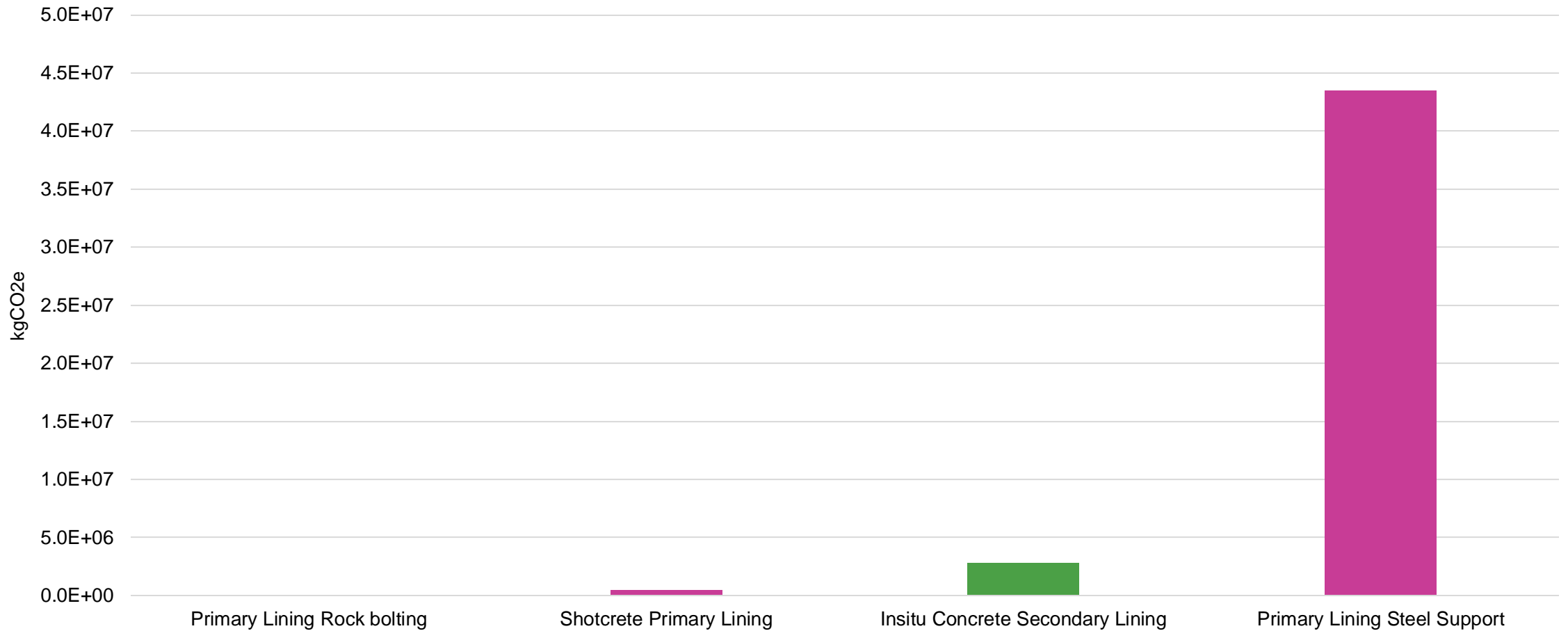


# ILC Shafts

## Sub-component Level

Primary lining  
Secondary lining

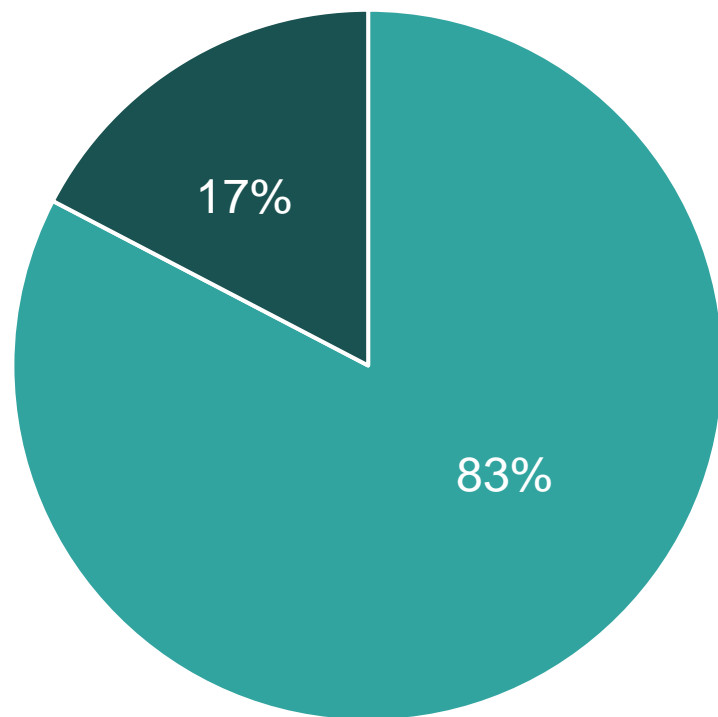
Shafts (kgCO<sub>2</sub>e)



*\*H200 and H125 spaced 1.5m along 70m deep main and utility shaft (assumption)*

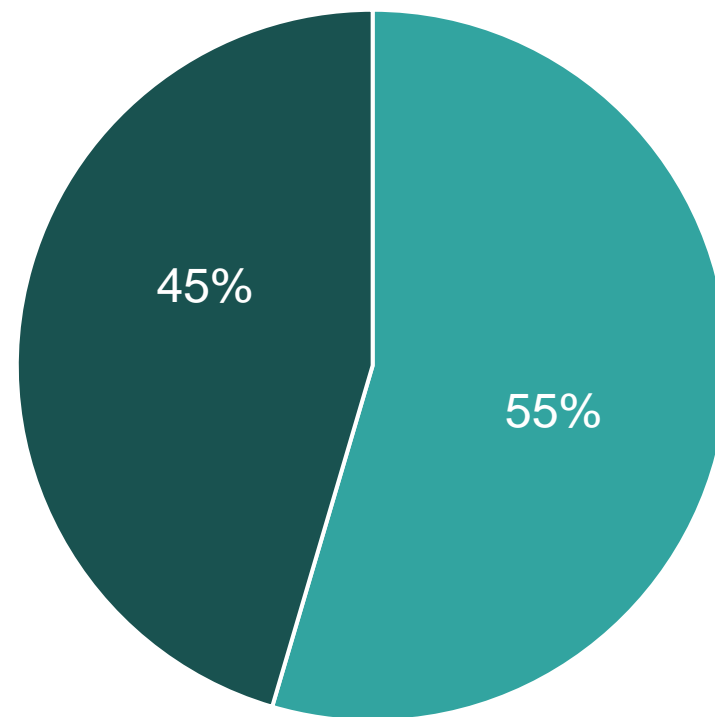
# Steel and Concrete Proportions

CLIC & ILC



CLIC 5.6m 3TeV & CLIC 10m 380GeV

Concrete  
Steel



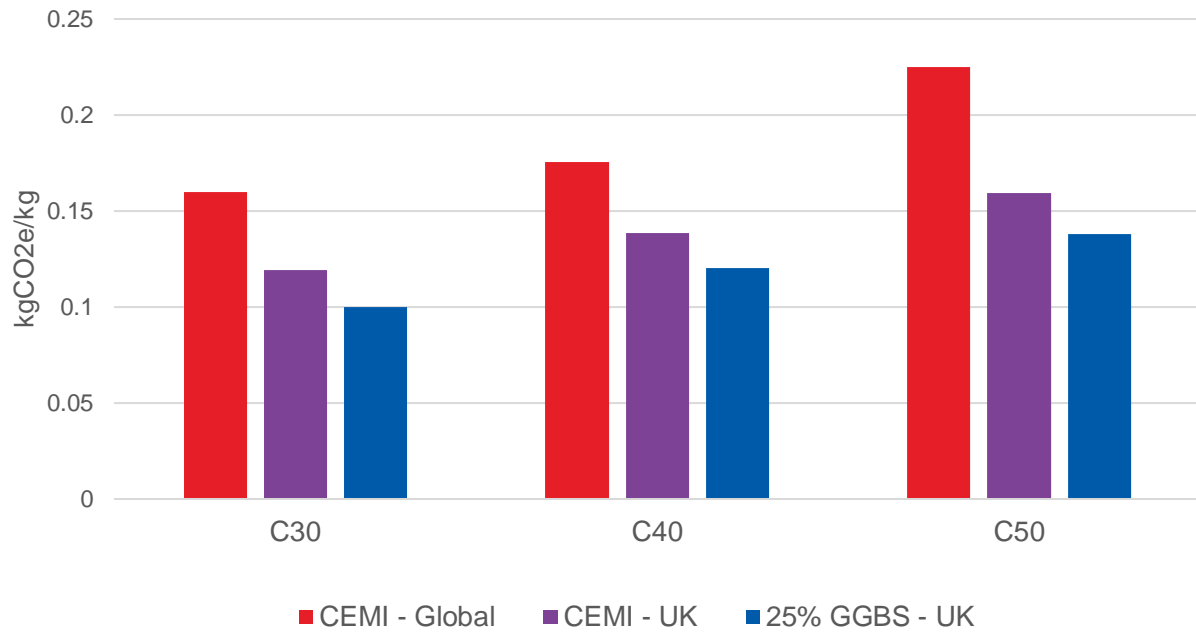
ILC 250GeV

# CERN Materials Baseline

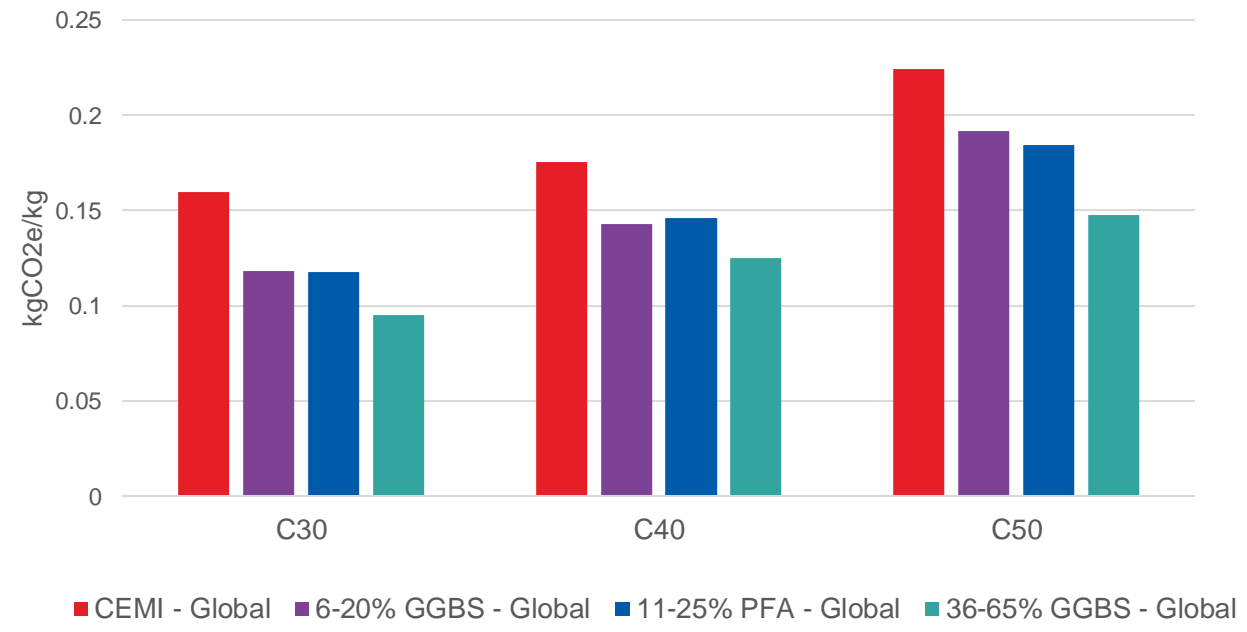
Option	Concrete	Rebar	Steel sections
CLIC 5.6m	CEMI	80% recycled	-
CLIC 10m	CEMI	80% recycled	-
ILC 9.5m	CEMI	80% recycled	80% recycled

# Concrete Carbon Factors

CEMI Carbon Factors Comparison

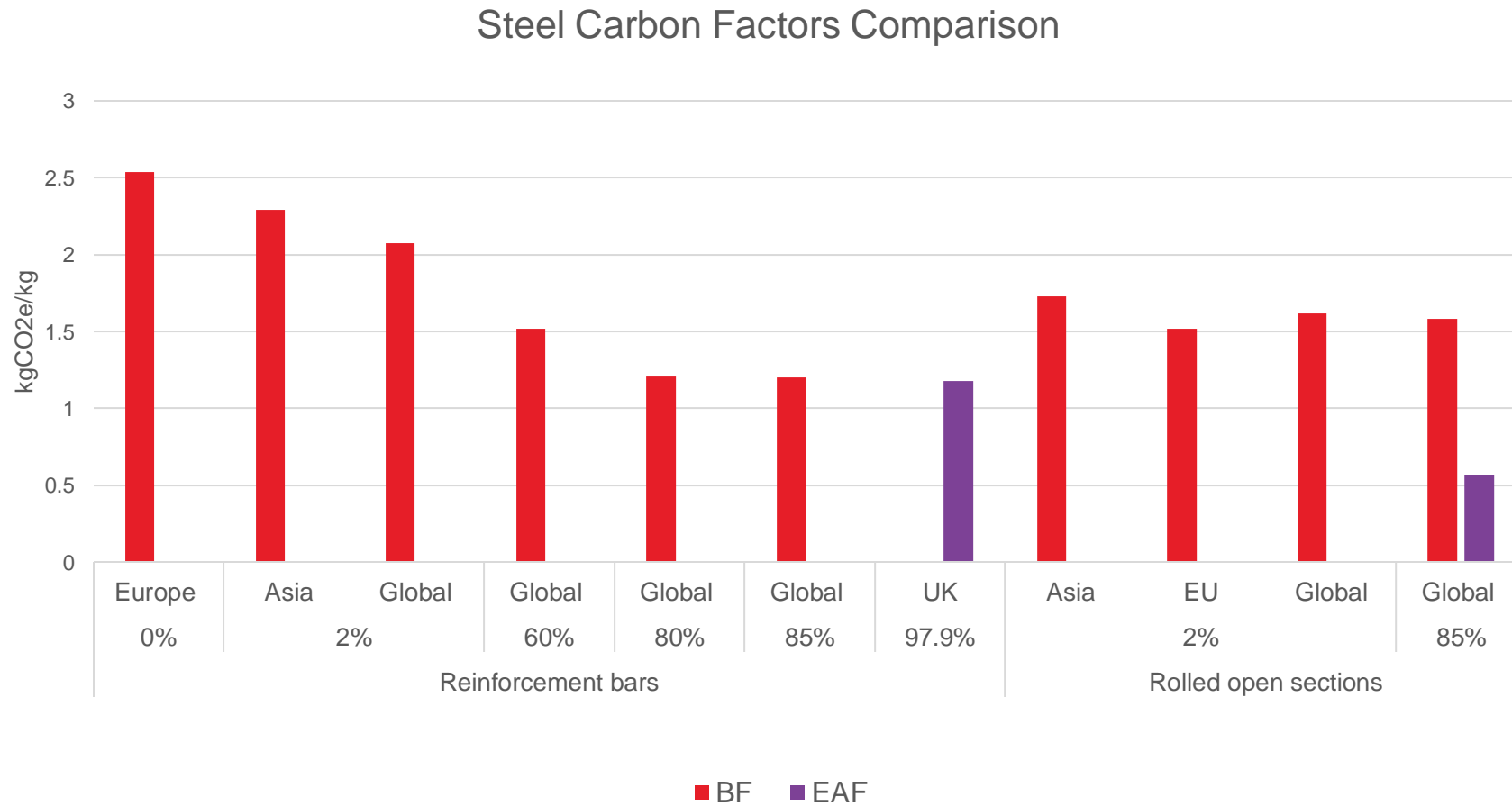


SCM Carbon Factors Comparison

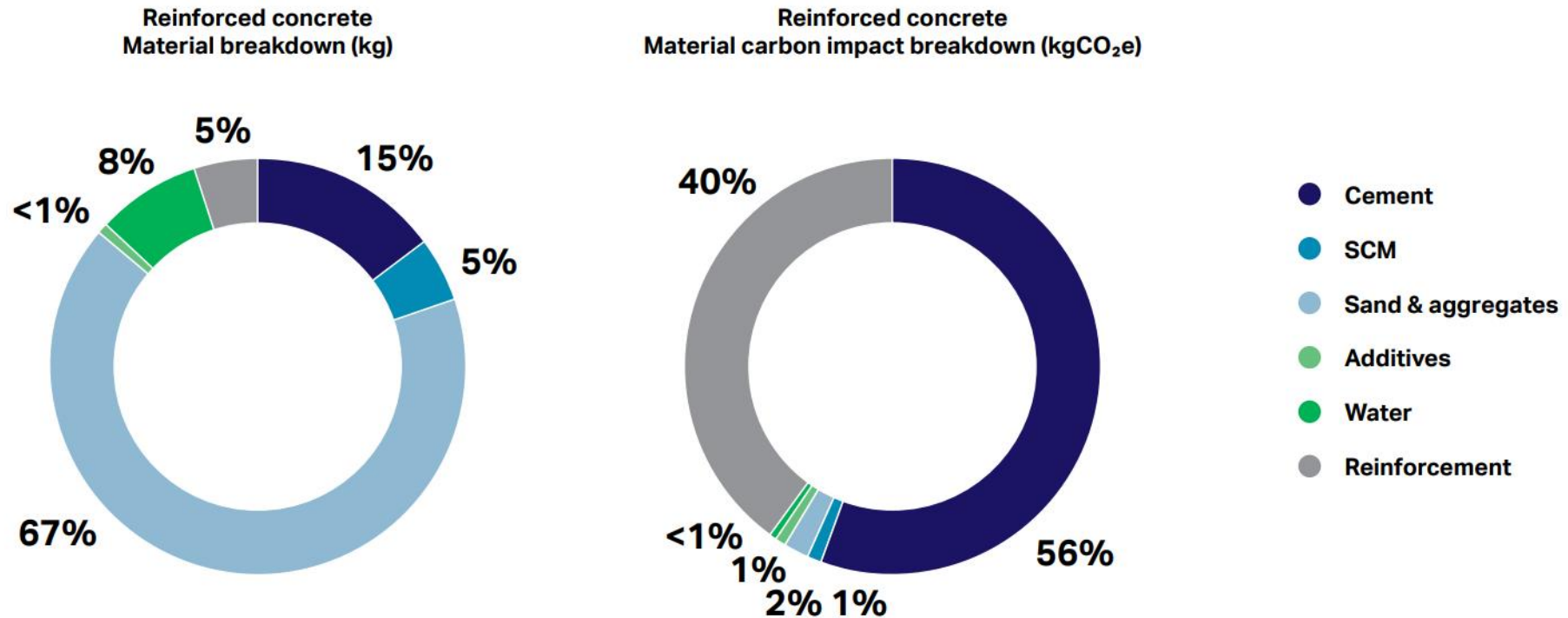




# Steel Carbon Factors



# Steel and Concrete Carbon Impacts

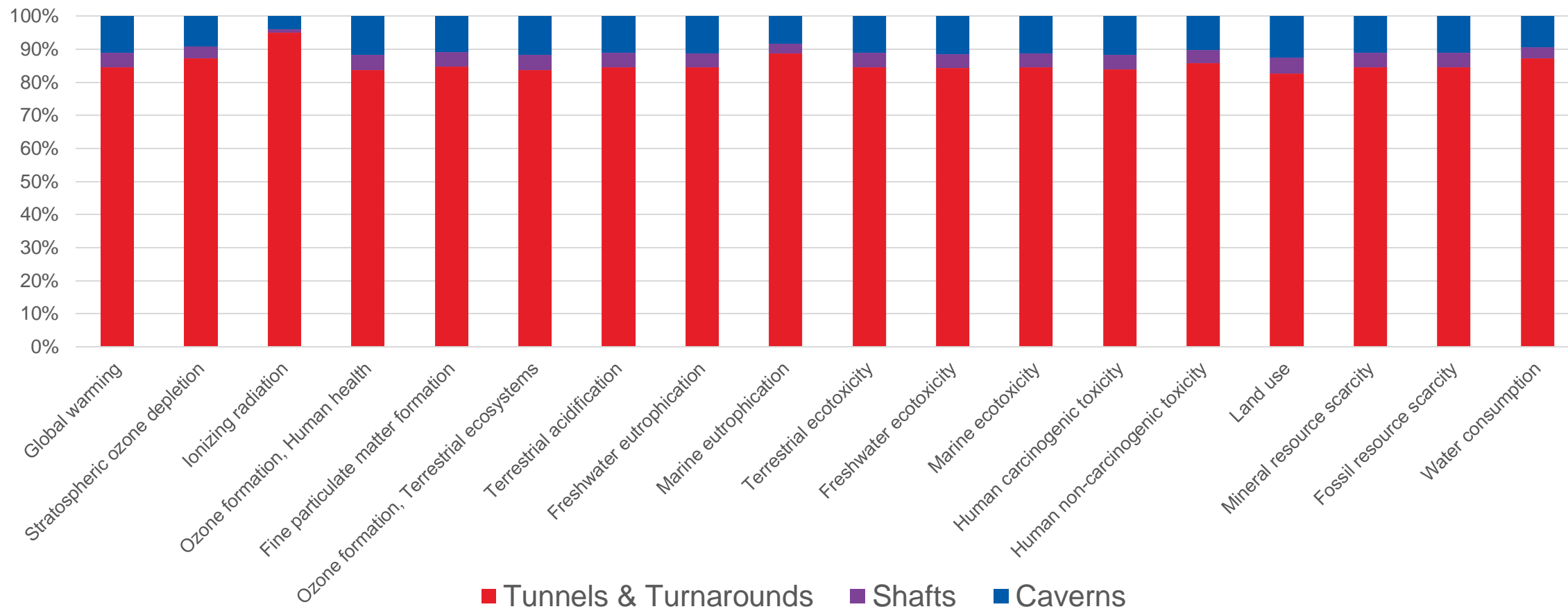


Ratios of material quantities versus material impact in a reinforced concrete mix C35/45

# CLIC 5.6m 3TeV

## A1-A3 LCA Results for ReCiPe 2016 Impact Categories

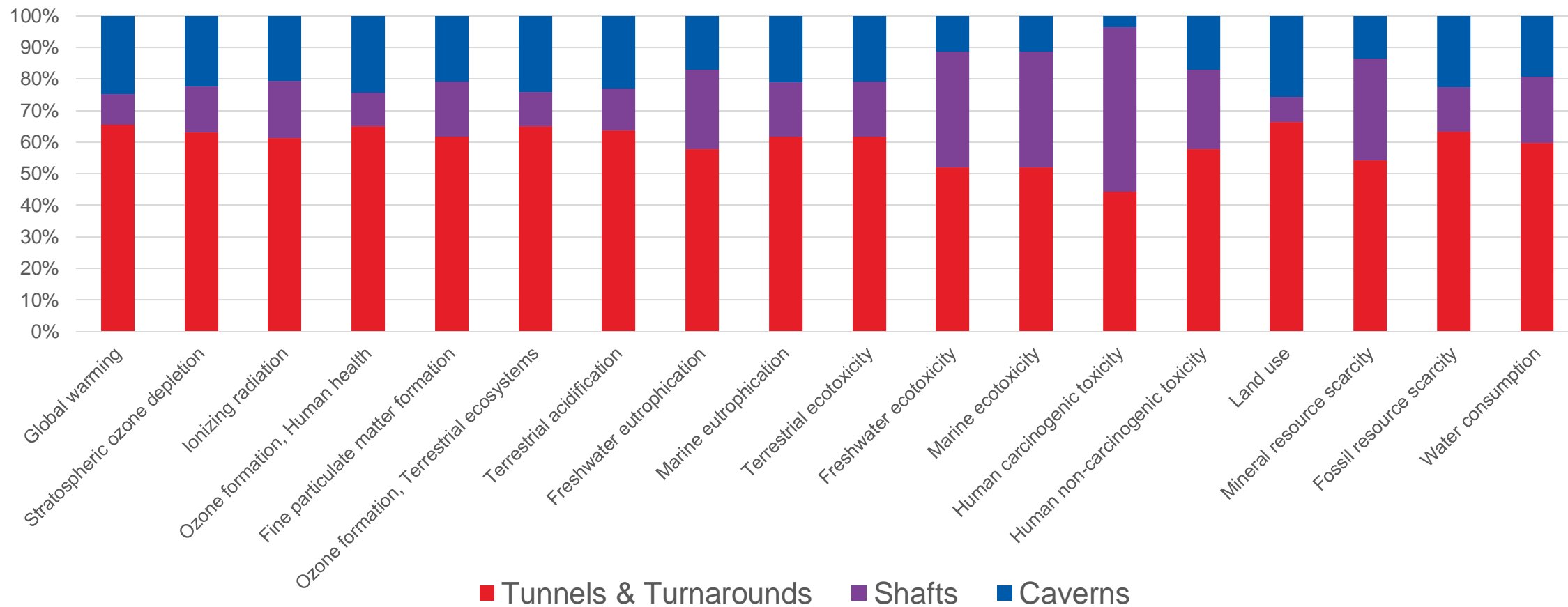
CLIC 5.6m 3TeV | Relative contribution of sub-system to total environmental impact



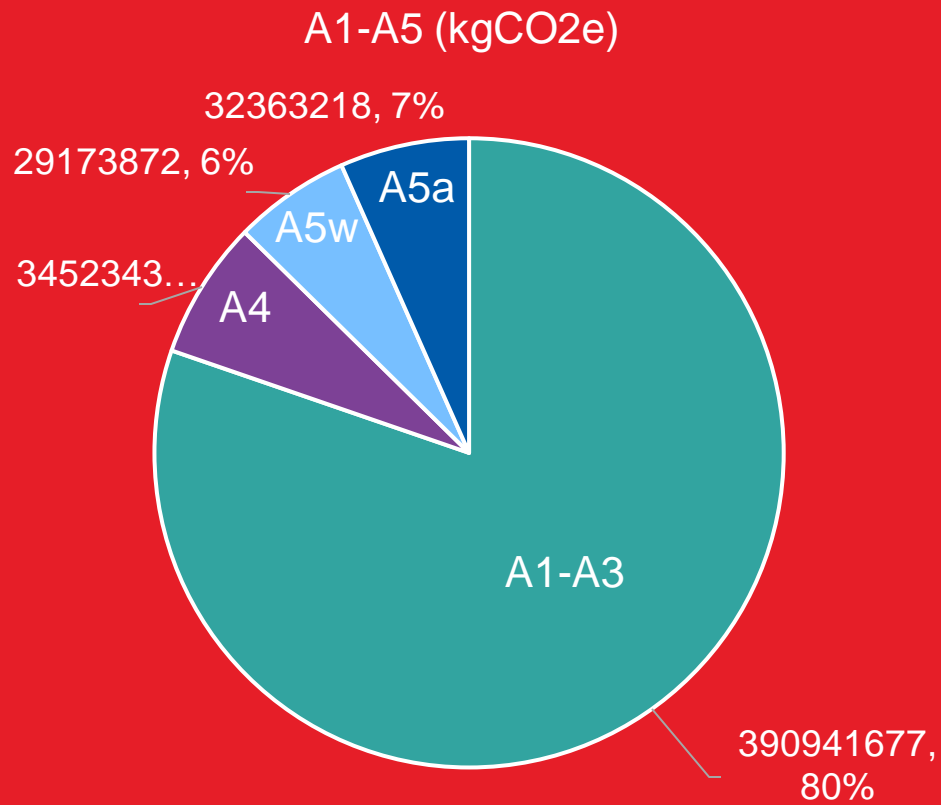
# ILC 250GeV

## A1-A3 LCA Results for ReCiPe 2016 Impact Categories

ILC 250GeV | Relative contribution of sub-system to total environmental impact

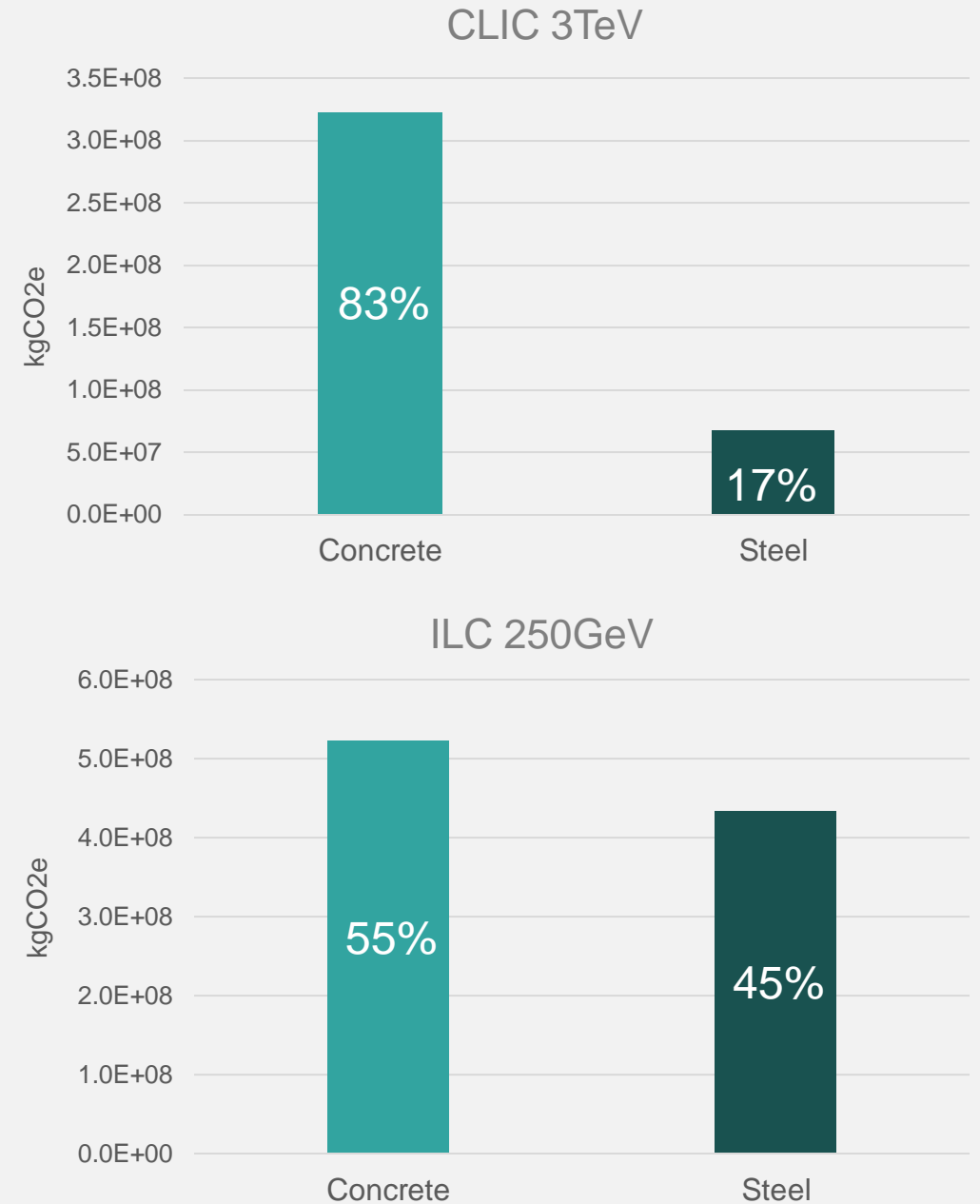


# CLIC 3TeV

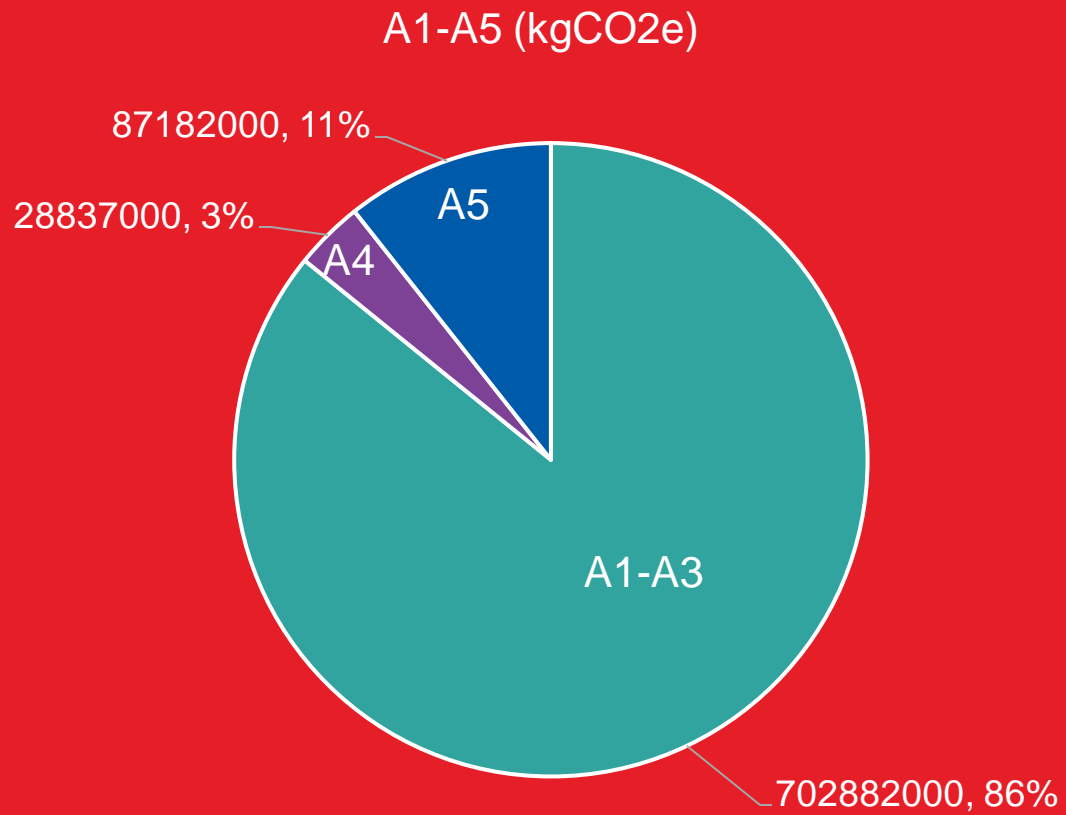


ILC 250GeV A1-A3: 697398793 kgCO2e  
(180% of CLIC 3TeV)

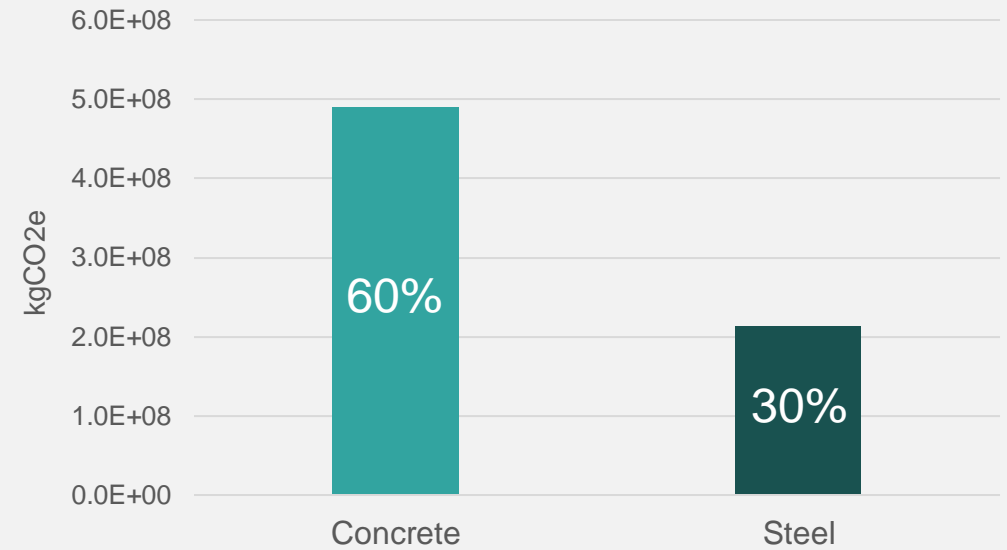
## A1-A3 Steel and Concrete Proportions (kgCO2e)



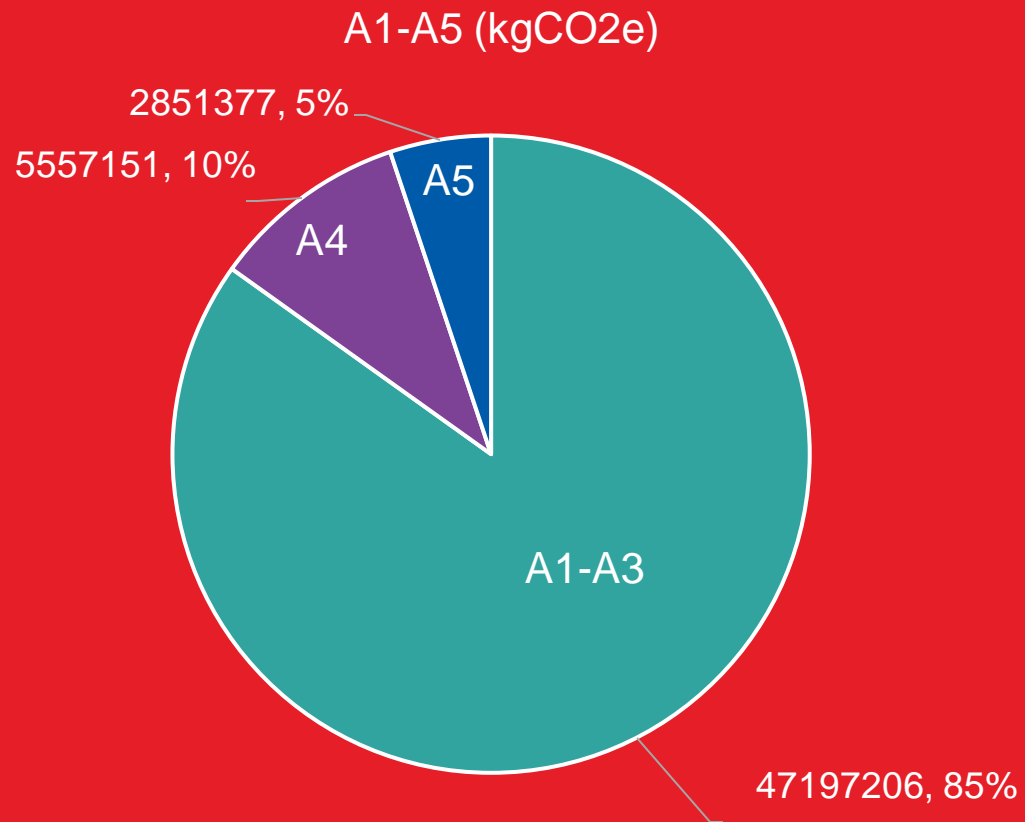
# Benchmark – Thames Tideway



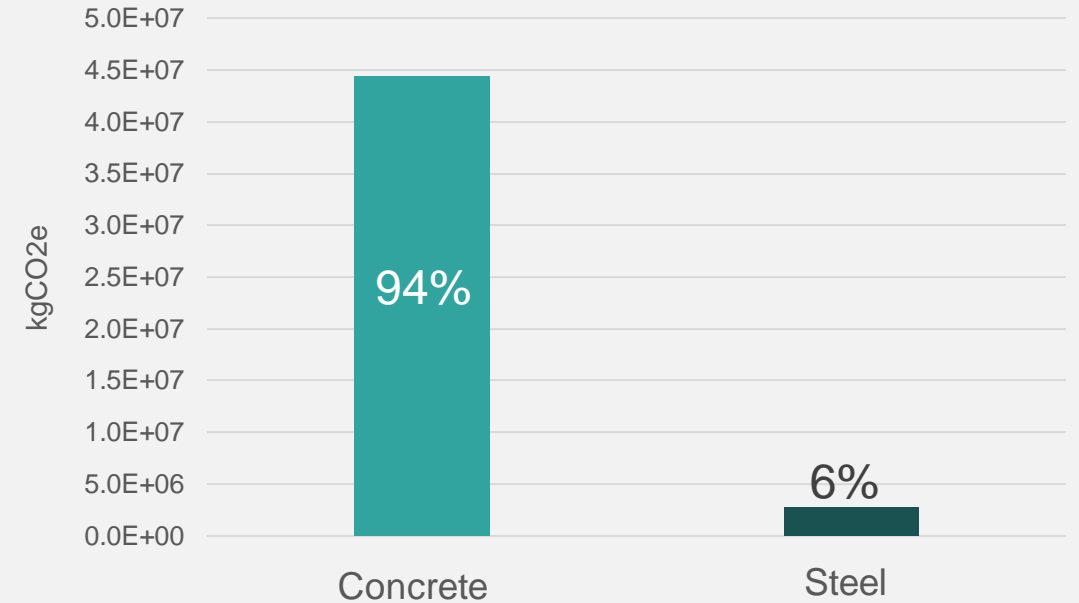
A1-A3 Steel and Concrete Proportions (kgCO<sub>2</sub>e)



# Benchmark – Railway Tunnel



A1-A3 Steel and Concrete Proportions (kgCO<sub>2</sub>e)

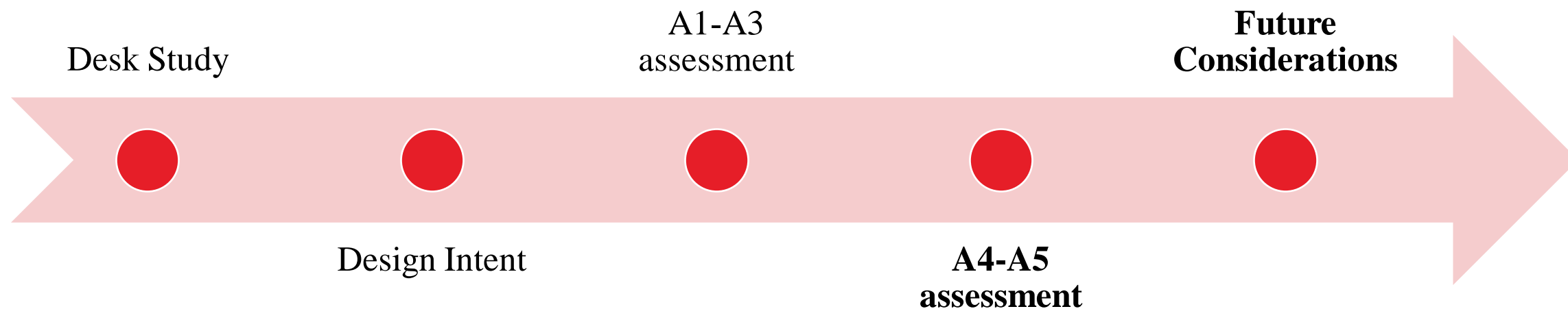


# Future Considerations



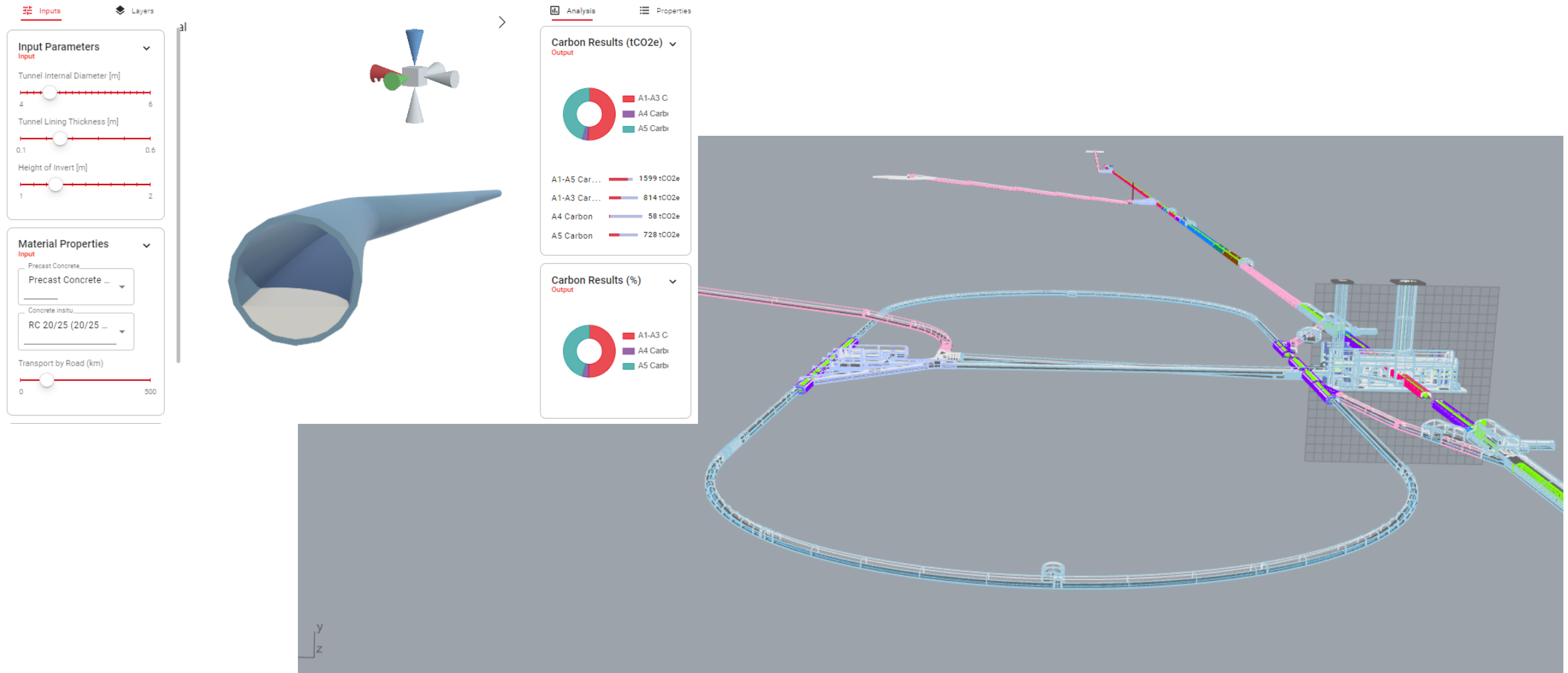
# Life Cycle Assessment – CLIC & ILC

## Next Steps



# Parametric Modelling

## CLIC & ILC



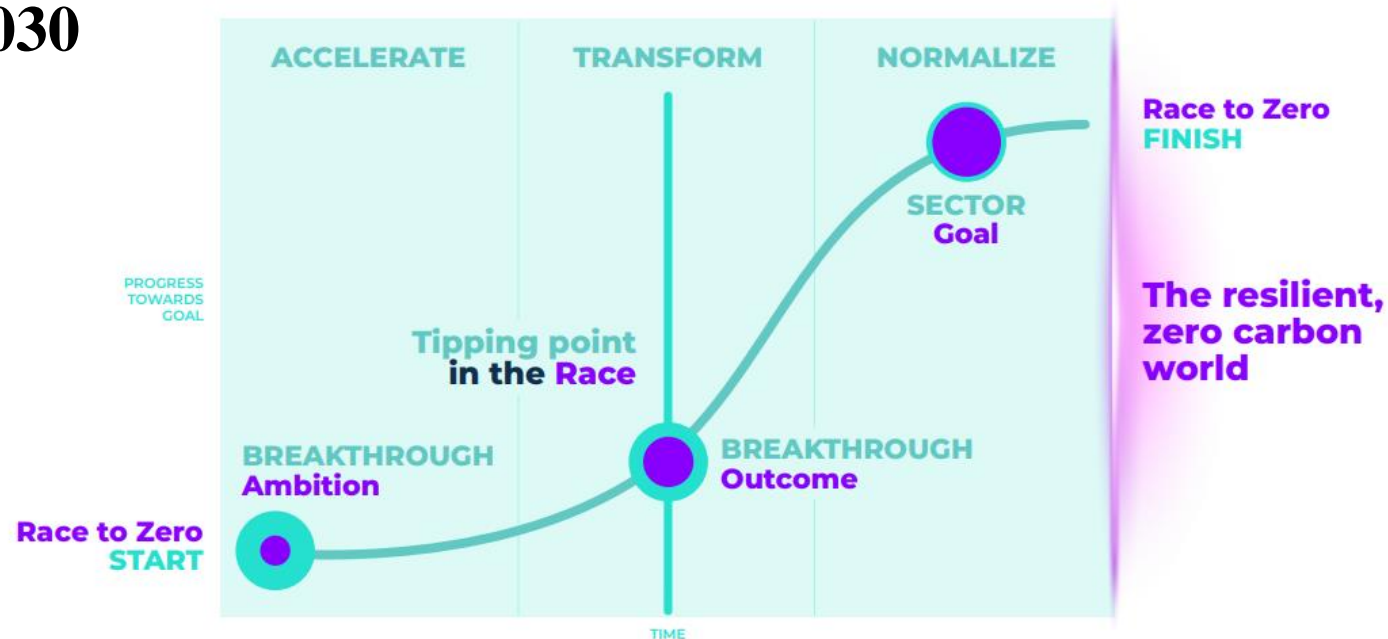
# Next steps – Future considerations

## Broader aims

## UN Breakthrough Outcomes for 2030

100% of projects due to be completed in 2030 or after are net zero carbon in operation

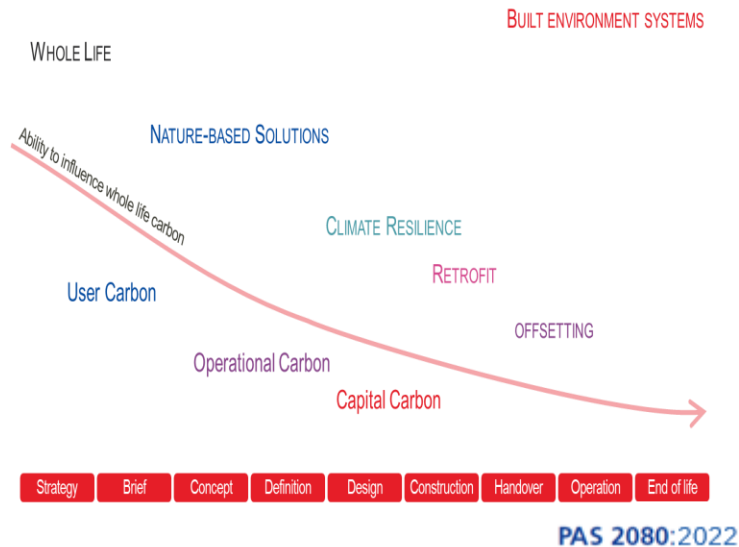
(with at least 40% less embodied carbon compared to current practice)



# Next steps – Future considerations

## Workshops

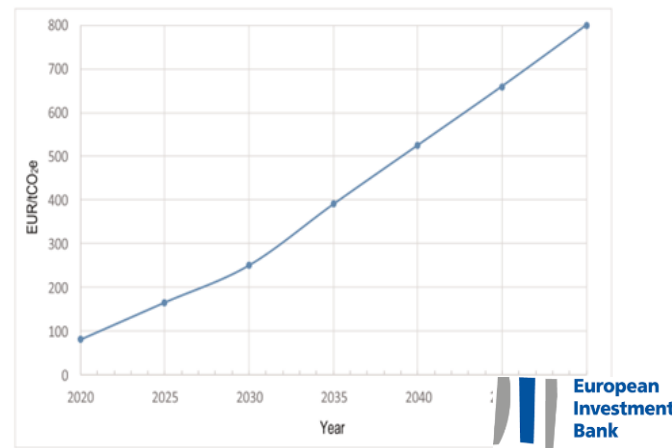
### Wider net zero considerations



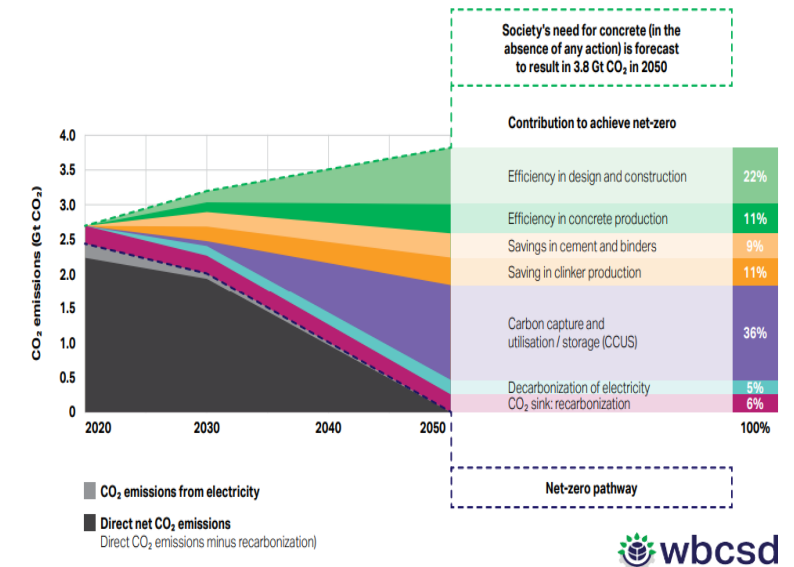
### Economic Drivers

EIB Shadow cost of Carbon price projections

2030: 250 €/tCO<sub>2</sub>e  
2050: 800 €/tCO<sub>2</sub>e



### Low carbon materials



ARUP